



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:  
Robert RICHARDSON et al.

Art Unit: 2838

Appl. No.: 10/734,605

Examiner: Not Yet Assigned

Confirmation No.: 1489

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Atty. Docket No.: 41557-199416

For: Transformer/Rectifier Arrangement

Customer No. 26694

**Submission of Certified Copy of Priority Document**

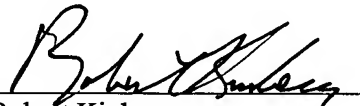
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA. 22313-1450

Sir:

Submitted herewith is a certified copy of Application No. 0114678.6 filed on June 15, 2001 in Great Britain, the priority of which is claimed in the present application under the provisions of 35 U.S.C. 119.

Respectfully submitted,

Date: 5/20/04

  
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INVESTOR IN PEOPLE

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I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation and Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein together with the Statement of inventorship and of right to grant of a Patent (Form 7/77), which was subsequently filed.

I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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*W. Behen*

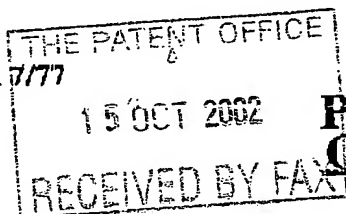
Dated 21 April 2004

*Attorney Docket No. 41557-1994/16  
Application No. 10/734,005*

*Application of Robert Richardson et al*



Patents Form 7/77

Patents Act 1977  
(Rule 15)The  
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15OCT02 B113980-2 000314

PG7/7705-2-01-24/1672-6  
The Patent Office**Statement of inventorship and of  
right to grant of a patent**Cardiff Road  
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- |                                                                                                    |                                                                                                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Your reference                                                                                  | P/63468.GBA/VMIC                                                                                                                                                                                                                    |
| 2. Patent application number<br>(if you know it)                                                   | 0114678.6                                                                                                                                                                                                                           |
| 3. Full name of the or of each applicant                                                           | MARCONI APPLIED TECHNOLOGIES LTD                                                                                                                                                                                                    |
| 4. Title of the invention                                                                          | TRANSFORMER/RECTIFIER ARRANGEMENT                                                                                                                                                                                                   |
| 5. State how the applicant(s) derived the right<br>From the inventor(s) to be granted a patent     | BY VIRTUE OF SECTION 39(1) OF THE UK PATENTS ACT                                                                                                                                                                                    |
| 6. How many, if any, additional Patents Forms<br>7/77 are attached to this form?<br>(see note (c)) | 0                                                                                                                                                                                                                                   |
| 7.                                                                                                 | I/We believe that the person(s) named over the page (and on any extra copies of this form) is/are the inventor(s) of the invention which the above patent application relates to.<br><br>Signature <i>Neng Hucker</i> Date 15/10/02 |
| 8. Name and daytime telephone number of<br>Person to contact in the United Kingdom                 | N. HUCKER 01245 493 493 (x3122)                                                                                                                                                                                                     |

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## Patents Form 7/77

Enter the full names, addresses and postcodes of the  
Inventors in the boxes and underline the surnames

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288 1175 002

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Patents ADP number (if you know it):

84 839 19 001

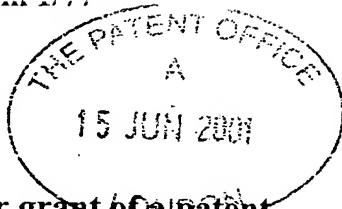
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1/77

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1. Your reference	P/63468.GBA/VMIC	18 JUN 01 2637/68-3 006256 P01/7700 0.00-0114678.6
2. Patent application number (The Patent Office will fill in this part)	<b>0114678.6</b>	15 JUN 2001
3. Full name, address and postcode of the or of each applicant (underline all surnames)	Marconi Applied Technologies One Bruton Street London W1X 8AG	

Patents ADP number (if you know it) 7811581001

If the applicant is a corporate body, give the Country/state of its incorporation United Kingdom

4. Title of the invention	TRANSFORMER/RECTIFIER ARRANGEMENT		
5. Name of your agent (if you have one)	N. Hucker		
"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)	Marconi Intellectual Property Marrable House The Vineyards Great Baddow Chelmsford Essex CM2 7DS	Reddie & Grose 16 Theobalds Road LONDON WC1X 8PL	

Patents ADP number (if you know it) 7873300001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number	Country	Priority application number (if you know)	Date of filing (day / month / year)
7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing (day / month / year)	
8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))	YES		

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Continuation sheets of this form	(0)
Description	5
Claim(s)	1
Abstract	1
Drawings	3 + 3

10. If you are also filing any of the following, state how many against each item.

Priority documents	(0)
Translations of priority documents	(0)
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	(0)
Request for preliminary examination and search (Patents Form 9/77)	(0)
Request for substantive examination (Patents Form 10/77)	(0)
Any other documents (please specify)	

11. ☒ I/We request the grant of a patent on the basis of this application.

Signature Nerys Hucker Date 15/06/01

12. Name and daytime telephone number of person to contact in the United Kingdom

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# TRANSFORMER/RECTIFIER ARRANGEMENT

The present invention relates to electrical transformer/rectifier arrangements.

Transformers are well known in the art for transforming electrical energy at an alternating voltage into electrical energy at another usually different alternating voltage without change of frequency. Transformers depend upon mutual induction and essentially consist of two electrical circuits magnetically coupled together. The usual construction comprises two coils or windings with a magnetic core disposed between them. The primary circuit receives energy from an AC supply whilst the secondary circuit delivers energy to a load, usually at a different voltage.

Often a DC voltage is required from the transformer and the AC voltage in the secondary circuit is rectified. Figure 1 shows a transformer having rectified secondary circuit known in the art. Primary circuit 10 comprises a primary coil 12 with an alternating voltage applied across it. The core 14 and secondary coil 16 complete the transformer. The alternating voltage induced in the secondary coil 16 is rectified by diodes 18 and 20 and capacitor 22 provide a steady DC supply to the load, not shown.

However, for example, in high voltage applications this rectified transformer arrangement can cause problems. The rectifier diodes can have excessive capacitance that degrades the voltage signal to the load. Furthermore, such systems and their components can be bulky and expensive.

The present invention aims to ameliorate the problems associated with the prior art discussed above, and in its broadest form, provides a rectifier transformer arrangement in which the rectifier components form a part of the secondary winding.

More specifically, the present invention provides a transformer comprising a primary winding, a secondary winding and a rectifier comprising a diode for rectifying voltage induced in the secondary winding, wherein the secondary winding comprises at least two coils, each coil including a rectifier diode as an integrated part of the coil.

The arrangement of the present invention has the advantage that the rectifier diodes are arranged as an integral part of the secondary winding, thus reducing the space occupied by the transformer/rectifier. Furthermore, the secondary winding can be constructed on printed circuit boards disposed either side of the primary winding, connected by the rectifier diodes and an electrical connector rod to form a single turn secondary winding. In this arrangement, two secondary windings, each of a single turn, can be provided. Moreover, using many diodes in parallel to one another reduced the overall capacitance and cost of the rectifier. The reduction in capacitance is especially useful for high voltage circuit applications.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 (referred to above) is a circuit diagram of a prior art rectifier/transformer described above,

Figure 2 is a circuit diagram of an embodiment of the present invention, and

Figures 3 and 4 are views of a transformer/rectifier arrangement embodying the present invention from the top and side respectively.

Referring to figure 2, a transformer/rectifier arrangement is shown. The secondary coil is split into two discrete windings 32, 34. Diodes 36, 38 and capacitor 40 rectify the alternating voltage induced in the secondary coils to provide a steady DC voltage to the load, not shown. The circuit in figure 2 behaves in the same manner as that shown in figure 1, however there are important advantages of

the circuit shown in figure 2 that are not present in prior art devices.

Referring to figure 3, a transformer primary coil and transformer core are housed in a cylindrical insulating plastic housing 40. Voltage is supplied to the primary coil by a cable 42 and cable socket 44. Printed circuit boards 46, 48 are disposed on either side of the primary coil housing 40. Electronic components 50 are disposed on circuit board 48 and include a capacitor as part of a rectifier circuit. The rectifier circuit is completed by diodes 52 disposed between the circuit boards 46, 48. The diodes are arranged in parallel and have the electrical characteristics of a single diode. The load to the transformer (not shown) .

Each of the two secondary windings of the transformer is a single turn coil comprising conductive strips (shown in fig 4) printed on each of the circuit boards 46, 48, connected by a central connector (not shown) passing through the centre of the primary coil/core housing 40, and the diodes 52. The diodes form an integral part of each secondary coil.

Referring to figure 4, the cylindrical primary coil block 40 protrudes from circuit board 46. The end pins 56 of the diodes 52 pass through the board 46. Conductive strips 58, 60 connect the diodes to the connectors 62, 64 passing through the primary coil/core housing 40. So, two discrete single winding secondary coils are formed. As can be seen from Figure 4, the secondary windings, including the diodes, form an arc around the outside of the primary coil housing 40.

The diodes connected to strip 58 are arranged in the opposite orientation to the diodes connected to strip 60. Circuit board 48 has a similar pair of conductive strips that connect the other ends of the connectors 62, 64 to the electronic components on the board to complete each secondary loop circuit. In this way, a compact arrangement of the circuit shown in figure 2 can be realised.

Such a transformer/rectifier arrangement can be used, for example, to drive a heater of a pulsed magnetron device. In such an application high voltages in the order of 60kV are required on the heater. The magnetron heater voltage is isolated from the supply voltage by the transformer arrangement. It is preferable to drive the heater with a DC voltage, although a VHF AC voltage could be used. It is also desirable to change the heater voltage as the magnetron is operated to compensate for fluctuations of primary and secondary emissions from the heater element, for example, as the magnetron warms up.

The embodiment shown in figures 3 and 4 can be used in such a magnetron application, as well as in other applications, and has several advantages over prior art systems. By placing many relatively small diodes in parallel to one another the overall capacitance of the rectifier circuit is reduced. For example, the overall capacitance can be reduced from roughly 1000pF to 9pF by replacing a single diode on each secondary coil with 10 diodes in arranged in parallel to one another. Furthermore, a single, high voltage diode is very much more expensive than many low voltage diodes arranged in parallel. This is particularly important in high voltage applications, such as is required for magnetron heaters.

Moreover, a single diode would have to be placed on a heat sink to dissipate heat energy from it. The embodiment shown in figures 3 and 4 can be immersed in a dielectric oil to directly insulate and cool the components. The oil may form part of a larger oil coolant/insulant reservoir as described in a system of our application GB-A-2356752.

Preferably, an electro-static shield is placed around the primary winding of the transformer to screen it from any electro-static charge created in the circuit. The shield is particularly important in HV environments; such a HV environment might be experienced in a pulsed magnetron device. The shield (not shown in figures 3 and 4) is disposed between the primary and secondary winding and

inside the block 40. In certain circumstances the shield can be extended to screen the secondary winding also.

The embodiment described provides a compact arrangement suitable for use, for example, with medical magnetron drivers or radar systems. Other systems requiring high voltage rectified transformers will also be able to take advantage of the present invention.

CLAIMS

1. A transformer comprising a primary winding, a secondary winding and a rectifier comprising a diode for rectifying voltage induced in the secondary winding, wherein the secondary winding comprises at least two coils, each coil including a rectifier diode as an integrated part of the coil.
2. A transformer according to claim 1, wherein each of the at least two coils is a single turn winding.
- 10 3. A transformer according to claim 1 or 2, wherein the rectifier diode of each coil comprises a plurality of diodes arranged in parallel to one another.
4. A transformer according to claim 3, wherein each of the at least two coils comprises conductive strips on a printed circuit board, and a connector for electrically connecting the conductive strips of each of the at least two coils.
- 15 5. A transformer according to claim 1, 2, 3 or 4, wherein the transformer is operable at high voltage.
6. A transformer according to any preceding claim for supplying power to a magnetron heater.
- 20 7. A transformer according to claim 6, where the magnetron is a pulsed magnetron.
8. A transformer, substantially as herein described, with reference to figures 2, 3 and 4 and of the accompanying drawings.
- 25

ABSTRACT

(Figs 2 & 3)

TRANSFORMER/RECTIFIER ARRANGEMENT

A rectifier transformer comprises two secondary windings, preferably with a single turn on each winding. The rectifier diodes form an integral part of each of the secondary windings. Thus, a compact arrangement is realised. In a high voltage application, the rectifier diodes comprise a plurality of relatively low voltage diodes in parallel to one another. The overall capacitance of the rectifier circuit is reduced by this arrangement.





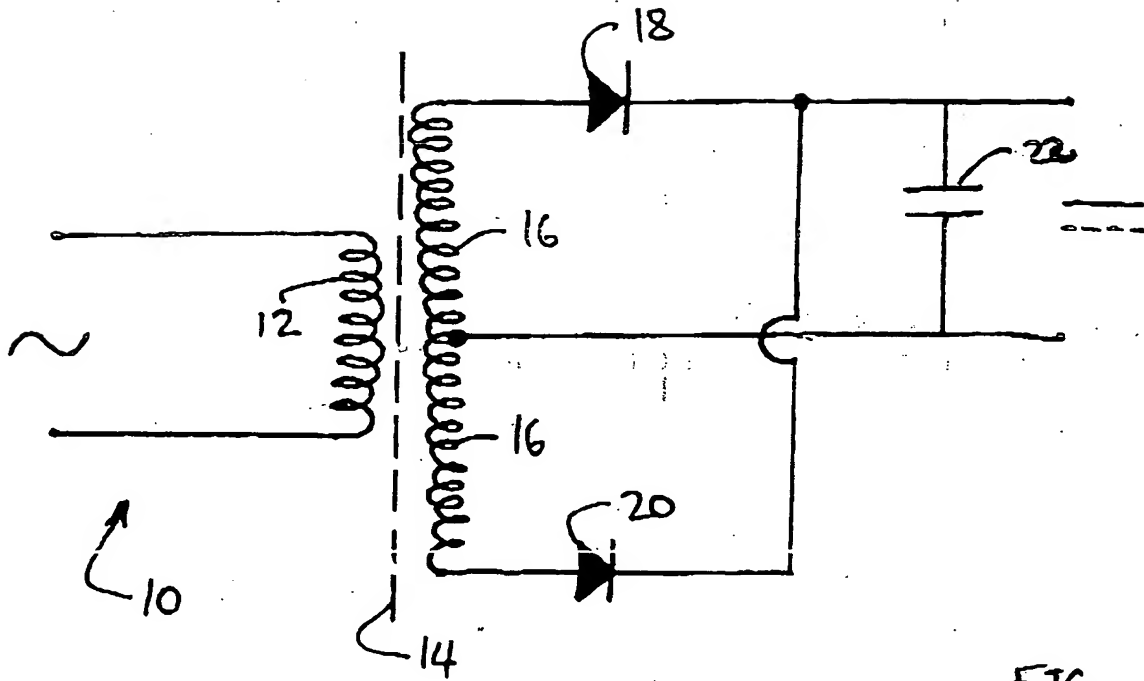


FIG. 1

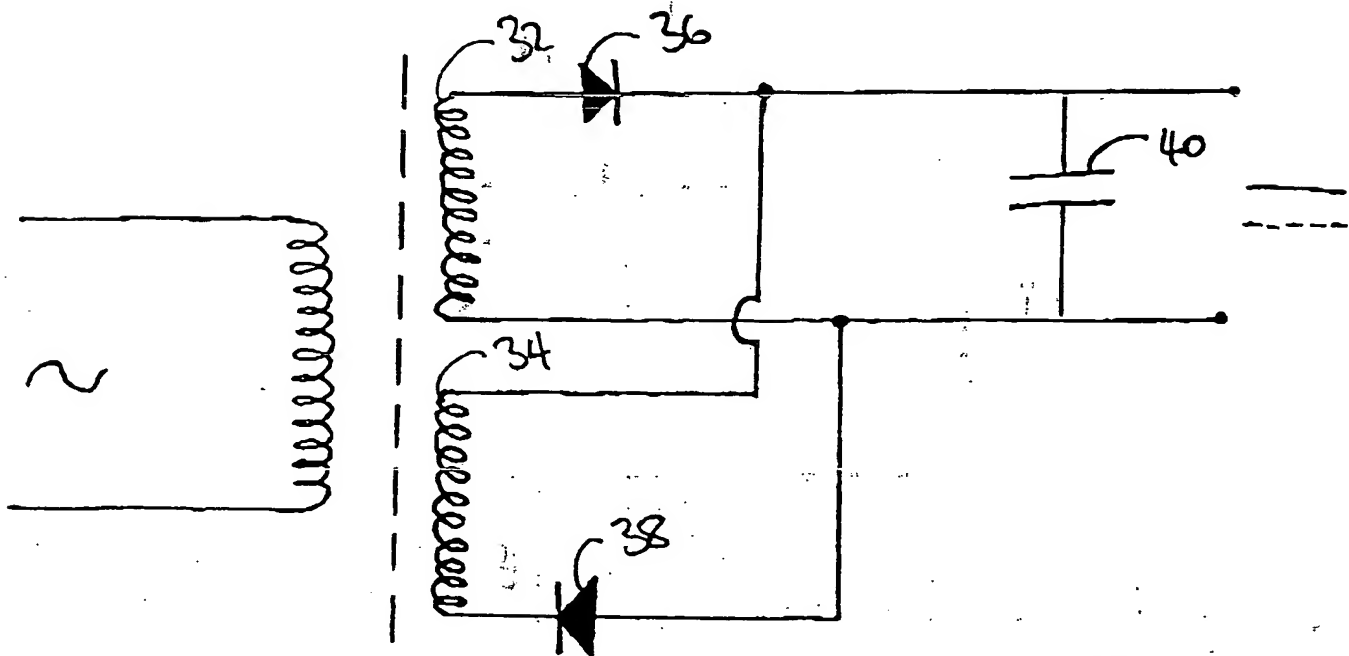


FIG 2.



FIG 3.

